



Higher Education in Hungary

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RECFA visit to Hungary, 23rd September, 2022

ECFA

European Committee for Future Accelerators



Some facts about Hungary

- **Population (2022): 9.7 million (0.65% decrease/yr)**
- **GDP (2021): 154 billion EUR ($\approx 1\%$ of EU27)**
- **GDP per capita: 18700 EUR (nominal)**
- **R&D expenditure: 1.56% of GDP**
- **Hungarian Academy of Sciences:
budget = 0.05% of GDP = 71 M EUR**
- **Eötvös Research Network: 165 M EUR**
- **Universities (state, 2022): 175 M EUR (0.11% GDP)**
- **Universities (non state): 468 M EUR (0.33% GDP)***



For comparison: MIT, USA, expenditure: 3778 M EUR

**will double next year - private foundations*

Elementary and Secondary education

- Students spend **12 years** in elementary and high schools
- Different choices: 8+4, 6+6, 4+8 years
- Some high schools offer advanced level **physics** and **mathematics**
- A few dozen students finish high school every year with excellent mathematics and physics background, **excellent** results in maths and physics international competitions, olympiads
- Talented students often choose **foreign** universities (Brexit and COVID had a counter-effect)



Higher Education

- 62 higher education Institutions
- Higher education belongs to the *Ministry of Culture and Innovation*
- Funding mostly **normative** (proportional to number of students)
- Present funding level: for **basic functions**, research can (only) be supported from external **grants**
- **Postdocs**: higher than basic salaries are mainly financed from competitive grants
- Most Universities were transferred from the state into the hands of **private foundations** recently



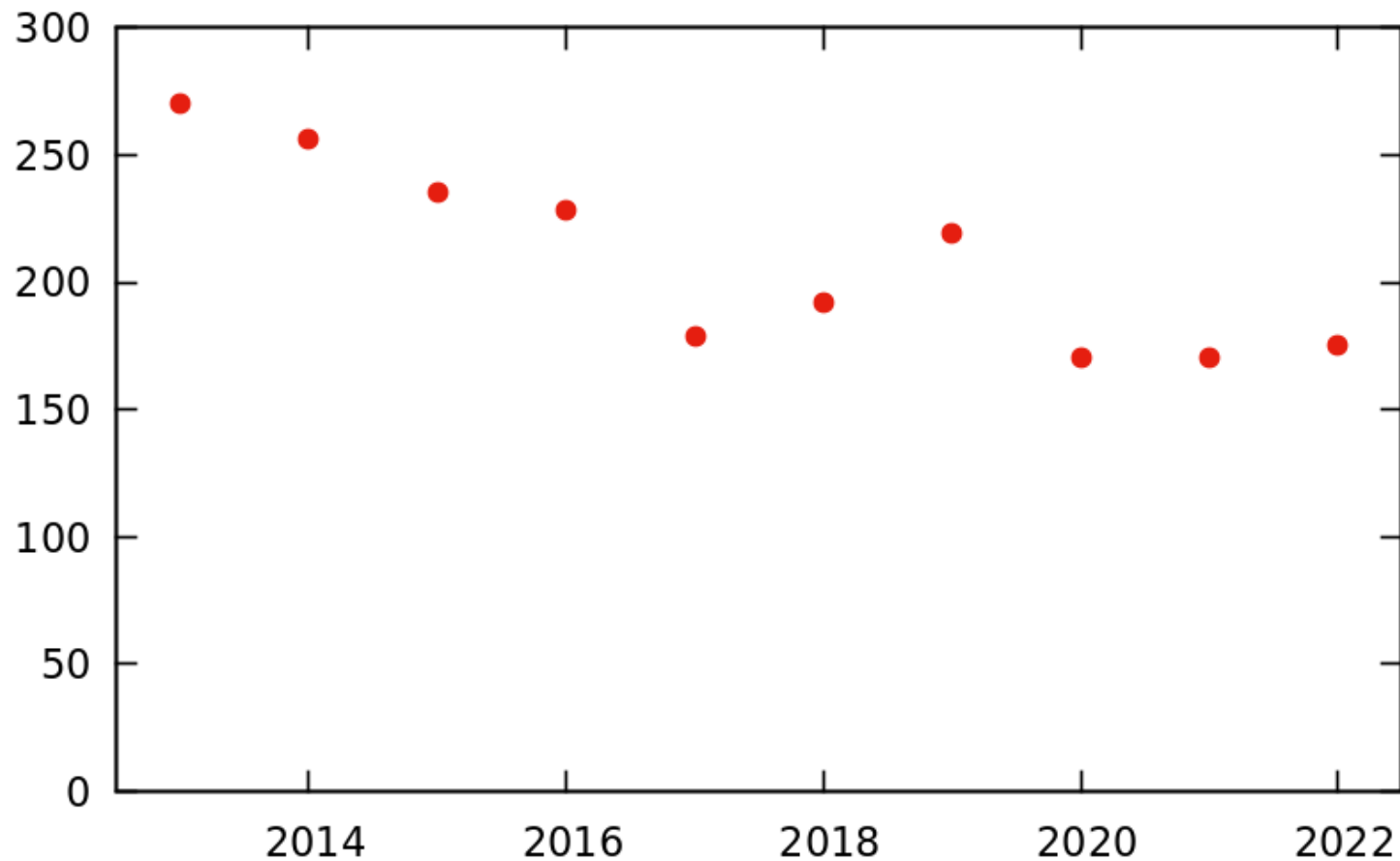
Physics at Hungarian Universities

- **Bologna** system: BSc: 3 years, MSc: 2 years, PhD: 4 years
- **Physics teachers**: unified 5-year education
- **Physics education at the BSc, MSc, PhD levels is offered by:**
 - **Eötvös Loránd University (ELTE),**
 - **University of Technology and Economics (BME),**
 - **University of Debrecen (DE),**
 - **University of Szeged,**
 - **University of Pécs.**
- **HEP, Particle/nuclear physics: ELTE, BME and DE**
- **Main profile for Pécs and Szeged is laser physics (ELI)**
- **The MSc and PhD programs at ELTE are fully in English**
- **ARWU 2022: Eötvös is ranked 105th in the world (233th in 2017), only Warsaw Uni is ranked higher in the region**



Number of BSc students

Number of physics BSc students starting their studies in Hungary:



Physics BSc at the Eötvös University

- **Around 100 physics students start every year**
 - **106 students in 2022 (23% women, increase from ~5% in the 1990's!)**
 - **69 students in 2022 at other Universities**
- **First two semesters: introduction-foundation courses (mostly mathematics: calculus, vector algebra and calculus, diff. equations, etc)**
- **Two levels (basic and advanced) of theoretical physics courses:**
 - **Mechanics, electrodynamics, quantum mechanics, stat. phys.**
- **Similarly two levels for higher mathematics and informatics**
- **Special directions from the 3rd semester**
 - **Physicist, physics with computers, bio-, geophysics, meteorology, astronomy**
- **Introductory HEP course in the last semester**

Education of Physics Teachers

- **5-year education**
- **26 students started their studies in 2021 in Hungary (down from 108 in 2013!)**
 - **About 50% finish their studies (~13/year)**
 - **Among them about 50% will indeed teach (~6/year!)**
 - **Number of active physics teachers in the age group 50-60 is more than 120/year (!)**
- **Incoming new students are unable to compensate for the 10-20 times more retiring teachers**
 - **Teacher's starting net salaries around 500 EUR/month**
- **4-year high schools now teach *physics* only in the first 2 years**

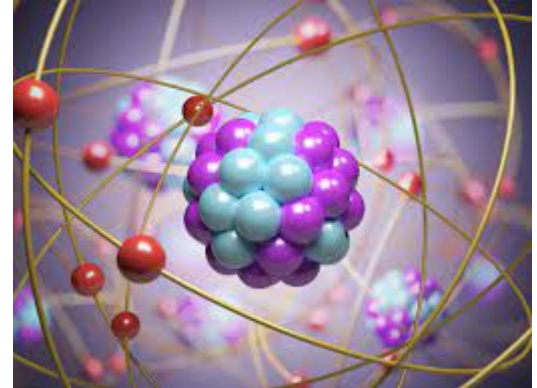


Physics MSc at the Eötvös University

- **27 students started MSc this year (15% females)**
 - **BSc mostly from Eötvös or Technical University**
- **Students can choose various topics like:**
 - **Astrophysics**
 - **Biological Physics**
 - **Condensed Matter Physics**
 - **Nuclear Physics**
 - **Particle Physics**
 - **Statistical Physics**
 - **Scientific Data Analytics and Modeling**
 - **Biophysics**
- **Students spend about a year on diploma thesis**
- **Many of them have publications before receiving MSc**

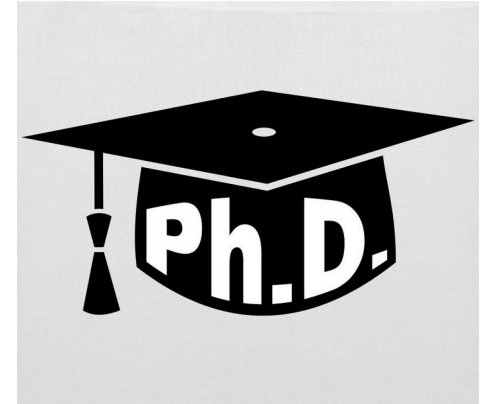
Particle Physics at MSc

- **Dominated by theory**
- **Compulsory courses:**
 - **Nuclear and Particle Physics**
 - **Nuclear and Particle Physics Laboratory**
- **Elective obligatory courses:**
 - **Particle and nuclear astrophysics**
 - **High-energy nuclear physics**
 - **Experimental methods in particle physics**
 - **Quantum field theory I and II**
 - **Renormalization**



PhD studies at the Eötvös University

- The best students often seek foreign PhD studies
- 5 PhD programs (English):
 - Materials and solid state physics
 - Particle and nuclear physics
 - Astronomy and space physics
 - Statistical, biological physics and quantum systems
 - Physics education (!)
- 25 students started in 2022 (32% females) with state scholarship:
 - 4 in Particle Physics (25% females) and 8 in Astronomy (50% females)
- Some students are employed at research institutes (in parallel), and/or win small grants (UNKP)
- Credits are collected from compulsory courses and freely chosen ones
- PhD students have 2-4 hours/week of teaching duties
- State scholarship is for 2+2 years, complex mid-term exam after 2 years, defense in the end (within 5 years)



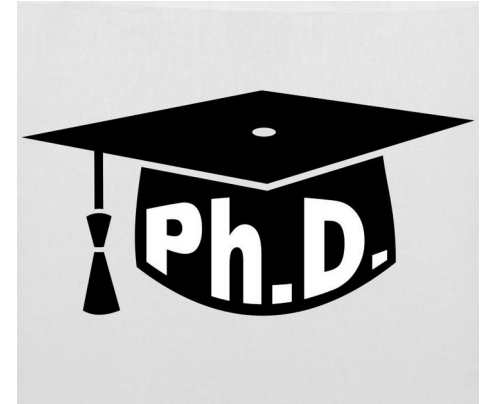
https://physics.elte.hu/physics_phd

PhD studies in Particle Physics

- **Large selection of freely chosen courses:**

- **Advanced field theory**
- **Standard Model**
- **Beyond the Standard Model**
- **Experimental methods in particle physics**
- **String theory**
- **Lattice gauge theory**
- **Solitons and instantons**
- **Inflationary cosmology**
- **Finite temperature quantum field theory**
- **Discrete gauge symmetries**
- **Conformal field theory**
- **Algebraic field theory**
- **Weak interaction**
- **Quantum Chromodynamics**
- **Quantum Electrodynamics**
- **Supersymmetry....**

- **Two peer-reviewed publications** are required for the PhD degree



PhD degrees awarded in the past years

	2022	2021	2020	2019	average 2019-21
All Hungary	24	47	39	52	46
Eötvös	4	22	13	26	20
Uni Debrecen	10	9	4	6	6
Technical Uni	8	10	12	10	11
All HEP	2	9	4	6	6
Eötvös HEP	0	6	1	1	3

About 50% of physics PhD students receive a degree

Fraction of females, physics

No official statistics, based on our own head-count:

- **Eötvös University, first-year BSc students: 23%**
- **University of Debrecen, all BSc students: 40%**

- **Eötvös University, first-year MSc students: 15%**
- **University of Debrecen, all MSc students: 0%**

- **Eötvös University, first-year PhD students: 32%**
- **University of Debrecen, all PhD students: 18%**

- **Eötvös University, assistant professors: 6%**
- **Eötvös University, associate professors: 0%**
- **Eötvös University, full professors: 0%**
- **Eötvös University, all professor faculties: 2%**



Note: students are identified by gender-neutral ID codes (exams etc)

Fraction of foreigners, physics

- **University of Debrecen:**
 - **all BSc students: 57%**
 - **all MSc students: 20%**
 - **all PhD students: 33%**
- **Eötvös University:**
 - **1st year BSc students: 0%**
 - **1st year MSc students: 7%**
 - **1st year PhD students: 20%**
 - **Postdoctors: 56%**
 - **all professor faculties: 6%**



Careers at Hungarian Universities

- **Four types of positions, all of them ≈permanent:**
 - **Assistant professor, most people enter at this level**
 - PhD required, has to get habilitation in 5 years
 - **Associate professor**
 - PhD and habilitation required
 - **Full professor**
 - PhD, habilitation and often DSc (HAS) required
 - **“Master teacher”**
 - PhD mostly required, teaching only
- **Postdoctors:**
 - **OTKA has some limited postdoctoral funding**
 - **Excellence grants allow international hires**

Net basic salaries at (state) Universities

- **PhD student, first 2 years: 350 EUR**
- **PhD student, second 2 years: 450 EUR**
- **Foreign postdoc: ~1000-1300 EUR****
- **Assistant professor: 460 EUR***
- **Associate professor: 650 EUR***
- **Full professor: 920 EUR***



These are net monthly salaries, calculated for a single person

*** recently increased by a 20-30% “supplement”, not included here;**

*** Some universities owned by Foundations (and research Institutes) had larger raises in the last year, not included here**

*** Can be supplemented by competitive grants, for some professors**

**** Foreign postdocs can only be attracted by more competitive salaries**

Research at Hungarian Universities

- **HEP research discussed in separate talks**
- **Funding almost exclusively from grants**
 - **Excellence grants, ~0.75M EUR/year each, total 37 M EUR**
 - **OTKA grants, ~100 kEUR each, total 30 M EUR for 4 years**
 - **ERC grants: Starting, Advanced and Consolidator grants**
 - **Momentum (Lendület) grants, ~0.5-1M each, 7 M EUR total similar to ERC, for establishing a new group**
 - **Forefront (“Élvonal”) grants, 7 M EUR total**
- **The Eötvös Network also supports selected research groups at the Universities**

THANK YOU FOR YOUR ATTENTION!